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PHYTOTOXICOLOGY SURVEY REPORT

CANADA METAL COMPANY LIMITED

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CANADA METAL COMPANY LTD. - TORONTO, 1992

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Abstract

Phytotoxicology Survey Report:
Canada Metal Company Limited - Toronto (1992)
Report No: SDB-025-3512-93

Tree foliage in the vicinity of the Canada Metal Company lead smelting, refining and fabricating plant in the South Riverdale area of Toronto and in a near-by residential control area was sampled in 1992. Elevated lead and, to a lesser degree, antimony and arsenic, concentrations were detected in foliage near Canada Metal with decreasing concentrations being detected with increasing distance from the plant.

Although only one site exceeded the urban Upper Limit of Normal guideline, the lead concentrations in the leaves of trees located closest to the CMC plant were about 15 time higher than in similar samples collected from the Gerrard Street Control Area. Concentrations in 1992 were similar to those encountered in 1991, and noticeably lower than those encountered prior to 1991.

On the basis of these results and supporting evidence from the air quality monitoring stations, it is apparent that CMC is a continuing source of lead emissions that are being deposited in the vicinity of the plant. Although air and foliar lead concentrations in the vicinity of the plant are generally within the appropriate criteria, they are nevertheless elevated beyond normal background concentrations.

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1 INTRODUCTION

Canada Metal Company Limited (CMC) operates a lead smelting, refining and fabrication facility at 721 Eastern Avenue in Toronto, Ontario. This operation has contributed to the burden of lead in the environment of the surrounding neighbourhood. Concern about this lead has promoted continuous and long-term monitoring activities by the Ministry of Environment and Energy (MOEE).

Among the monitoring activities is the collection and analysis of tree foliage from the immediate vicinity of CMC. This program has been conducted by the Phytotoxicology Section of the Air Resources Branch (presently of the Hazardous Contaminants Branch) since 1972. A recent report[1] reviewed tree foliage data from 1986 through 1991. The primary purpose of this report is to present the most recent, 1992, data on foliage chemistry and compare them to the relevant air quality data.

This report will also consider data from 1989 through 1991 to place the 1992 data into perspective. The neighbourhood near CMC was subjected to extensive replacement of contaminated soil between 1987 and 1989, with most of the activity occurring in 1988. Consequently, this report shall establish a new baseline for following lead contamination in the CMC area; the time following the soil clean-up. Restriction to this time period also eliminates the need to consider leaded gasoline which used to be a significant and ubiquitous source of lead.

2 PHYTOTOXICOLOGY INVESTIGATIONS, 1992

2.1 CMC Tree Foliage Survey Design

A series of trees that had been sampled in September of 1989, 1990 and 1991 were sampled again in September, 1992. The locations of the sampled trees are presented in Figure 1. The majority of these collection sites are located on residential properties, usually in front yards, in the neighbourhood immediately north of CMC. Other sites include a park, a school, and industrial/commercial properties. This area is generally known as 'South Riverdale'.

The sampled trees include more than one species. This concession was necessary due to a lack of one common species throughout the survey area. On occasion, a replacement tree had to be sampled because the original tree died or was removed. The replacement was in the immediate vicinity of the original tree. Table 1 identifies the species sampled at each location between 1989 and 1992. Table 1 also records where sampling of a replacement tree commenced.

2.2 Sample Collection, Processing and Analysis

Sample collection consisted of cutting branches from the sides of trees facing CMC with pruning poles, removing the foliage and placing this foliage into polyethylene bags with sample number tags. Duplicate samples from each tree were collected in 1989 through 1991.

Processing involved oven-drying of the foliage, removal of any remaining non-foliage material (fruit, twigs) and grinding the sample in a rotating, stainless steel blade (Wiley™) mill to pass through a one-millimetre screen.

Processed samples were submitted to the MOEE Laboratory Services Branch and analyzed for lead, antimony, arsenic and cadmium using standard, documented analytical procedures.

FIGURE 1: LOCATIONS OF TREE FOLIAGE COLLECTION SITES AND AIR QUALITY MONITORING STATIONS

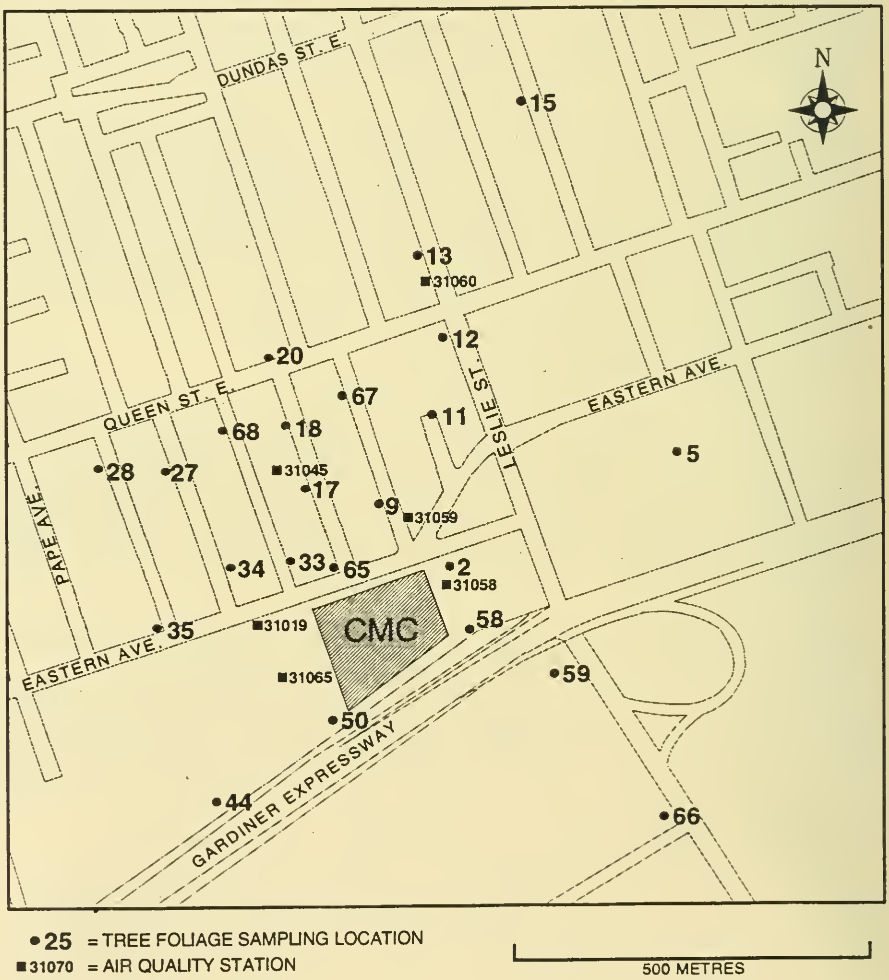


Table 1: Tree Species Sampled in the Canada Metal Company Limited Survey, 1989 - 1992

Site	1989	1990	1991	1992
58	Ailanthus	~	~	~
50	Willow	Locust	~	~
65	Norway Maple	~	~	~
59	Norway Maple	~	~	~
2	Norway Maple	~	~	~
33	Norway Maple	~	~	~
9	Elm	~	Norway Maple	~
34	Norway Maple	~	~	~
17	Norway Maple	~	~	~
44	Willow	Ailanthus	~	~
35	Silver Maple	~	~	~
11	Willow	~	~	~
18	Norway Maple	~	~	~
67	Silver Maple	~	~	~
68	Norway Maple	~	~	~
27	Norway Maple	~	~	~
5	Linden	~	~	~
12	Elm	~	~	~
20	Silver Maple	~	~	~
66	Poplar	~	~	~
28	Norway Maple	~	~	~
13	Norway Maple	~	~	~
15	Norway Maple	~	~	~

~ = same tree sampled as in preceding year

2.3 Gerrard Street Control Area Survey

The Gerrard Street Control Area (GSCA) is located approximately 1.5 kilometres WNW of CMC. It is comprised primarily of a residential neighbourhood very similar to the one north of CMC, in terms of age and residential property characteristics. It would be similarly affected by general urban contaminants, including lead, as would be the South Riverdale area. However, the South Riverdale area differs since it contains a point source of lead, CMC.

The GSCA consists of 10 sampling sites. Each site has both a Norway Maple and Ailanthus tree located close together. As in the CMC survey, sampling was conducted in September of each year from 1989 to 1992. Sample collection, processing and analysis procedures were identical to those employed in the CMC survey.

3 AIR QUALITY MONITORING

The MOEE Central Region monitors air quality around CMC. The monitors consist of suspended particulate (HiVol) samplers and dustfall jars. Lead concentrations are determined in the suspended particulate and dustfall samples.

3.1 Suspended Particulate Sampler Locations

In 1989 through 1992, there were three locations within the CMC tree foliage survey area where lead in suspended particulates was determined. These locations, designated as Nos. 31058, 31065 and 31045, are indicated in Figure 1.

A suspended particulate sampler, No. 31082, is located immediately west of the GSCA. It also operated between 1989 and 1992. This sampler is considered to be outside the influence of CMC.

3.2 Dustfall Sampler Locations

Between 1989 and 1992, there were five locations within the CMC tree foliage survey area where lead in dustfall was determined. These locations are also indicated in Figure 1 and are designated with numbers 31058, 31059, 31065, 31019 and 31060.

An additional lead in dustfall sampler, No. 31082, is co-located with the suspended particulate sampler west of the GSCA.

4 RESULTS OF TREE FOLIAGE CONTAMINANT SURVEY

4.1 Lead in Tree Foliage

Table 2 reports the concentrations of lead encountered in tree foliage collected in 1989 through 1992 in the vicinity of CMC. This table also contains the average concentrations for locations within 350 metres of CMC, and the average concentrations for locations beyond 350 metres of CMC. Also reported are average concentrations for all foliage samples collected in the GSCA.

Foliar lead concentrations exceeded the Phytotoxicology Upper Limit of Normal (ULN) guideline *(See appendix for explanation of ULN guidelines)* at some collection sites within 350 metres of CMC in every year from 1989 to 1992. However the frequency and magnitude of these exceedances declined through this period, as did the concentration means.

It should be noted that the ULN guideline for lead in urban tree foliage is based on samples collected in the early 1980s and previously. These samples would have been affected by the historical use of leaded gasoline. Consequently, the ULN likely overestimates the background foliar lead concentration. The ULN is used solely to maintain consistency in the series of Phytotoxicology reports addressing CMC.

Table 2: Lead Concentrations (ug/g)[*] in Tree Foliage near CMC and in the GSCA: 1989 to 1992

	Site No.	Distance (m)	1989	1990	1991	1992
CMC Sites < 350 m from CMC	58	90	210	15	64	13
	50	150	170	175	78	57
	65	150	49	115	23	35
	59	200	255	69	48	46
	2	200	200	185	57	63
	33	220	47	53	16	24
	9	240	104	115	11	24
	34	285	21	30	11	17
	17	300	20	33	7	11
	44	330	50	41	21	17
	35	345	45	57	13	15
	Mean		106	81	32	29
CMC Sites > 350 m from CMC	11	360	44	40	17	30
	18	365	14	13	7	9
	67	400	17	20	5	6
	68	410	5	9	4	6
	27	425	21	16	7	14
	5	470	43	43	19	20
	12	485	16	39	10	32
	20	490	9	9	4	6
	66	495	11	12	7	7
	28	500	12	10	4	7
	13	575	16	24	5	11
	15	730	7	13	2	4
	Mean		18	20	8	12
GSCA	Mean		6	5	3	2

[*] dry weight, mean of duplicate samples
Shaded data exceed the urban ULN of 60 ug/g (see Appendix).

4.2 Antimony, Arsenic and Cadmium in Tree Foliage

All tree foliage samples from the CMC area collected in 1989 through 1991 were also analyzed for antimony, arsenic and cadmium, because these elements are suspected of being associated with lead emitted by CMC. Data up to and including 1991 were presented and discussed in the previous Phytotoxicology report[1].

The 1992 concentrations of these three elements were, as previously, frequently below analytical detection limits. The exceptions are listed in Table 3 along with the respective ULN guidelines.

Table 3: Analytically Detectable Antimony, Arsenic and Cadmium Concentrations in Tree Foliage near CMC: 1992

Antimony (ug/g)*		Arsenic (ug/g)*		Cadmium (ug/g)*	
Site 2	2.4	Site 2	1.2	Site 11	2.4
Site 65	1.6			Site 66	1.8
Site 50	1.4				
Site 9	1.2				
ULN	0.5	ULN	2.0	ULN	2.0

* dry weight, mean of duplicate samples

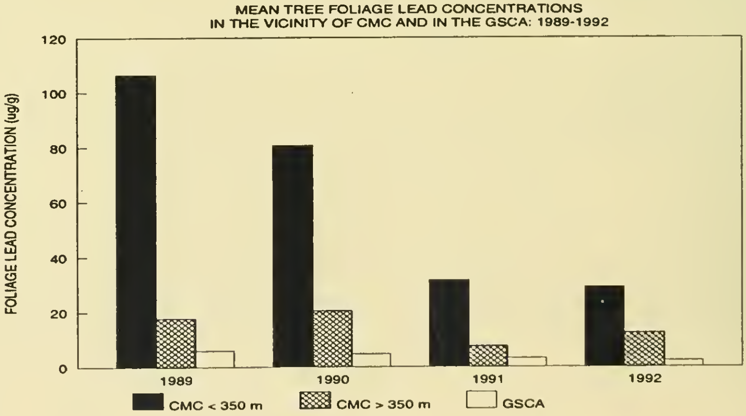
Antimony was detected at four locations, all close to CMC. The concentrations exceeded the ULN guideline. Arsenic was detected at one of these four stations. Cadmium was only detected at locations where cadmium accumulator species (willow and poplar) were sampled. These species were sampled because they were part of a long-term sampling network. They were established as sample trees because there were no alternative species available in those locations.

These limited data support the conclusion reached in the previous report[1]. CMC is also a source of antimony and arsenic.

5 LEAD IN FOLIAGE TRENDS NEAR CMC AND IN THE GSCA

The mean concentrations of lead in tree foliage in 1989 through 1992 at sites less than 350 metres from CMC, at sites more than 350 metres from CMC, and in the GSCA are graphically presented in Figure 2. Lead concentrations in foliage closer to CMC are consistently higher than in foliage at sites farther from CMC, which in turn are higher than in foliage from the GSCA.

FIGURE 2:



MEAN TREE FOLIAGE LEAD CONCENTRATIONS IN THE VICINITY OF CMC AND IN THE GSCA: 1989-1992

This pattern is a clear indication that CMC is still a source of lead. Emissions of lead from this source impact neighbouring properties, including the residential properties north of Eastern Avenue.

As was reported previously[1], foliar lead concentrations in 1991 were dramatically lower than they were in any previous year. The average 1992 foliage concentrations are very similar to those of 1991. Although substantially lower than in previous years, in 1992 foliar lead concentrations within 350 metres of CMC were about 15 times higher than in the GSCA.

6 AIR QUALITY MONITORING

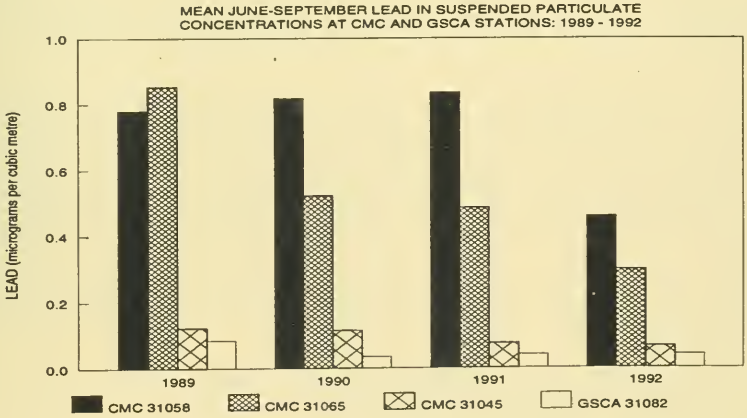
Air quality monitoring in the vicinity of CMC is conducted by the MOEE Central Region. The data are maintained in the Air Quality Information System (AQUIS) database. These data are presented in this report to corroborate what is reflected in the foliar lead concentrations. Consequently, the only air quality data considered are for the summer months June, July, August and September, since air quality conditions during these periods are most likely to be reflected in foliar concentrations.

6.1 Lead in Suspended Particulates

Figure 3 represents the summer month averages of lead in suspended particulate concentrations for the years 1989 to 1992. Each of the three collectors in the CMC vicinity (31058, 31065 and 31045), and the GSCA collector (31082) are represented.

The Ambient Air Quality Criterion for suspended particulate lead is 3 ug/m^3, determined as the arithmetic mean of daily samples collected in a 30 day period. This criterion was not exceeded in any of the summer months from 1989 to 1992.

FIGURE 3:



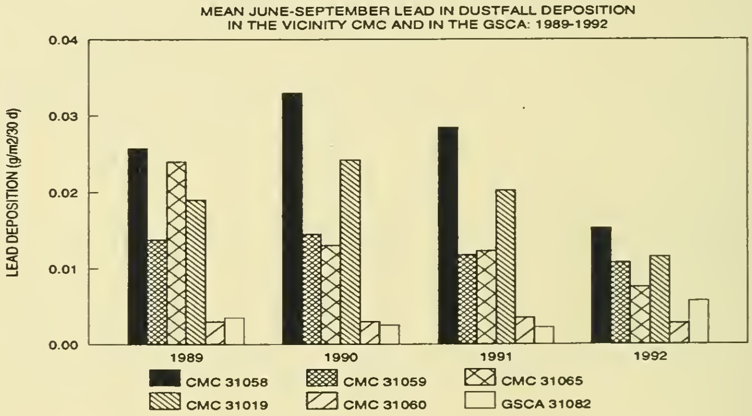
MEAN JUNE-SEPTEMBER LEAD IN SUSPENDED PARTICULATE CONCENTRATIONS AT CMC AND GSCA STATIONS: 1989 - 1992

6.2 Lead in Dustfall

Figure 4 represents the summer month average lead deposition as measured by dustfall collectors in 1989 through 1992. There were five collectors positioned around CMC during this period with an additional collector in the GSCA.

The Ambient Air Quality Criterion for lead in dustfall is 0.1 gram per square metre per 30 days (g/m^2/30 d). According to the AQUIS, this criterion was not exceeded during the summer months of 1989 through 1992 at any of the collector locations considered in this report.

FIGURE 4:



6.3 Foliar Lead Concentrations Versus Air Quality Measurements

The air quality data for lead in suspended particulates and in dustfall corroborate the foliar lead concentration data. Specifically, air quality monitors located close to CMC intercept greater quantities of lead than do monitors located farther away. This pattern is consistent with foliar lead concentrations. With one exception (CMC 31065 in 1992), the lowest quantities of lead are recorded at the GSCA air quality monitoring location.

These data clearly document that CMC releases lead into the environment, and that this lead impacts locations beyond CMC property lines.

An analysis of the three data sets reveal that lower lead values in the air quality measurements occurred in 1992, whereas the foliage data showed this decline in 1991, and maintained it in 1992.

The significance of this apparent discrepancy is difficult to evaluate. Regardless of this temporal difference, the spatial patterns are consistent.

7 SUMMARY AND CONCLUSIONS

In September, 1992, the Phytotoxicology Section collected tree foliage samples from the vicinity of Canada Metal Company (CMC), and from the Gerrard Street Control Area (GSCA). These samples were analyzed for lead and other contaminants. The data revealed that CMC was the source of lead, as well as antimony and arsenic, contamination of tree foliage.

Lead in suspended particulates and dustfall data were also reviewed. All data sources agreed that the elevated lead concentrations were a function of the proximity to CMC.

Foliar lead concentrations, as well as lead measured by air quality instrumentation, was lower in 1992 than in previous years. While foliar concentrations declined in 1991, air quality measurements did not reveal a similar decline until 1992.

8 REFERENCE

[1] Gizyn, W. I., 1993, *Investigations of Tree Foliage Contamination in the Vicinity of Canada Metal Company Limited, Toronto, 1986-1991*, Ministry of Environment and Energy, Air Resources Branch, ARB-040-92-Phyto, March, 1993

9 APPENDIX

Derivation and Significance of the MOEE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

The MOEE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a pollution source. Urban ULN guidelines are based on samples collected from urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (reference: Ontario Ministry of the Environment, 1989, *Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxiology Samples*, Phytotoxicology Section, Air Resources Branch; Technical Support Sections NE and NW Regions, Report No. ARB-138-88-Phyto, ISBN 0-7729-5143-8). Chemical analyses were conducted by the MOEE Laboratory Services Branch.

The ULN is the arithmetic mean plus three standard deviations of the suitable background data for each chemical element and parameter. This represents 99% of the sample population. This means that for every 100 samples that have not been exposed to a pollution source, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOEE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.